

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

ERT3046 – MACHINE VISION
(RE)

07 OCTOBER 2015
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question Paper consists of 5 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

- a) In **Figure Q1.1**, let $V=\{1\}$, show the shortest path between P and Q for:
- (i) 4-adjacency; [2 marks]
 - (ii) 8-adjacency; [2 marks]
 - (iii) m -adjacency. [2 marks]

	0	0	0	0	1	Q
	0	0	0	0	1	
	0	1	1	1	0	
	0	1	0	0	0	
P	1	1	0	0	0	

Figure Q1.1

- b) Describe the concept of bit-plane slicing with an aid of illustration. [8 marks]
- c) **Figure Q1.2** shows a general representation of a mask. Derive an expression for the weight, w which will preserve corners. x is a variable. [6 marks]

	x	1	x	
x				
1		w		1
x				
		1		

Figure Q1.2

- d) **Figure Q1.3** shows an image where the objects are marked as value 1 (dark grey shaded). Show the result of morphological *OPENING* on the image using the structuring element as shown in **Figure Q1.4**. [5 marks]

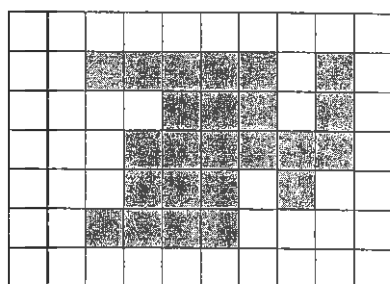


Figure Q1.3



Figure Q1.4

Continued...

QUESTION 2

- a) A *signature* is a 1-D functional representation of a boundary and may be generated in various ways. One of the simplest is to plot the distance from the centroid to plot the distance from the centroid to the boundary as a function of angle.
- i) Sketch the distance $r(\theta)$ versus angle θ (in degrees) *signature* for the shapes shown in **Figure Q2.1** and **Q2.2** with the reference point marked as "o" and the starting point marked as "x". Traverse the boundaries in **anti-clockwise** direction. [12 marks]
- ii) What do you think can be done to make the *signature* shape representation invariant towards any change in rotation and scaling? [4 marks]

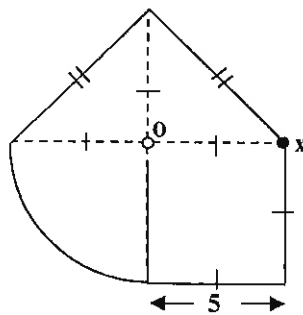


Figure Q2.1

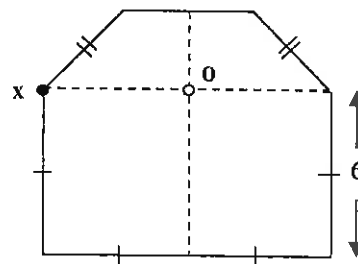


Figure Q2.2

- b) From **Figure Q2.3**, determine the order of the shape number. Extract the 4-direction chain code in **clockwise** direction and obtain the shape number. [1+4+4 marks]

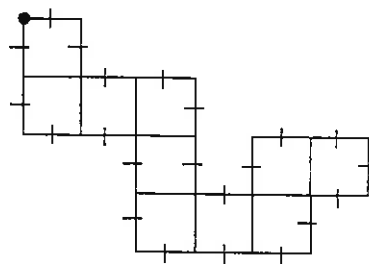


Figure Q2.3

Continued...

QUESTION 3

- a) **Figure Q3.1** shows an image with **TWO (2)** possible intensity levels. Obtain the gray level co-occurrence matrix if the displacement or position vector, d is
- $d = (-1, 1)$. [4 marks]
 - 'two (2) pixels to the right and one (1) pixel below'. [4 marks]
 - Calculate the entropy and contrast of the image based on the results of **part (ii)**. [7 marks]

1	1	0	1	1	0
0	1	1	0	0	1
0	0	0	0	1	0
1	0	1	0	1	0
1	0	1	1	1	1
0	1	0	1	0	1

Figure Q3.1

- b) Autocorrelation function $p[k, l]$, for an $N \times N$ image is defined as:

$$p[k, l] = \frac{\frac{1}{(N-k)(N-l)} \sum_{i=1}^{(N-k)} \sum_{j=1}^{(N-l)} f(i, j) f(i+k, j+l)}{\frac{1}{N^2} \sum_{i=1}^N \sum_{j=1}^N f^2(i, j)}, \quad 0 \leq k, l \leq N-1$$

- What is the application of autocorrelation function in texture analysis? [2 marks]
- Compute the autocorrelation, $p[k, l]$ for the binary image segment be $f(x, y)$ as show in **Figure Q3.2**. [8 marks]

	1	2	3
1	1	1	1
2	0	1	1
3	0	0	1

Figure Q3.2

Continued...

QUESTION 4

- a) Briefly describe **THREE (3)** phases of Dynamic Vision Analysis. [6 marks]
- b) **Figure Q4** shows **THREE (3)** classes which are classified by their extracted features. Determine to which class ***m*** is classified into by using 5-nearest neighbour class. (use *Euclidean distance as the distance metric and round to two nearest figure*) [11 marks]

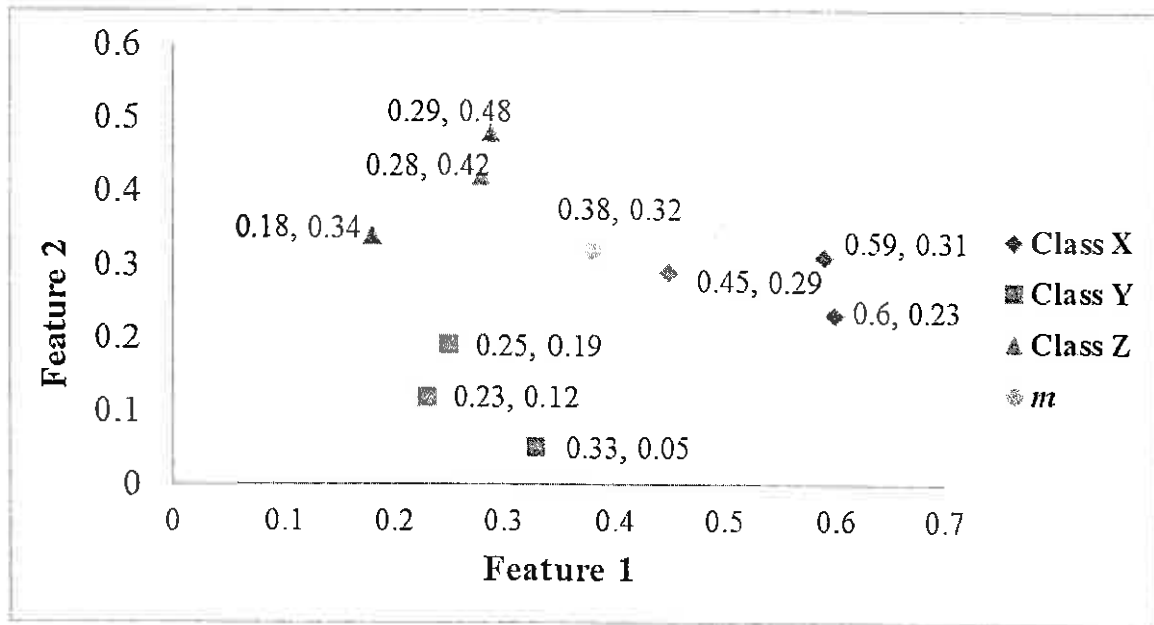


Figure Q4

- c) **Table Q4** shows a confusion matrix for a character recognition problem attempting to classify characters from 'A' to 'E'. There are 500 feature vectors in total to represent 500 alphabets. 'R' indicates 'reject' class. From the confusion matrix,
- calculate the error rates for all the inputs. [5 marks]
 - which input alphabet produces the least classification error? [1 mark]
 - compute the reject rate for the classifier. [2 marks]

Table Q4

	'A'	'B'	'C'	'D'	'E'	'R'
'A'	97	1	0	0	1	1
'B'	0	95	0	3	2	0
'C'	0	2	93	4	0	1
'D'	1	0	0	98	0	1
'E'	0	0	0	0	99	1

End of Paper